

HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:

Portage Bay (UW) Coho Program

**Species or
Hatchery Stock:**

Coho (Onchorynchus kisutch)
Lake Washington

Agency/Operator:

Washington Department of Fish and Wildlife

Watershed and Region:

Lake Washington
Puget Sound

Date Submitted:

March 17, 2003

Date Last Updated:

December 14, 2002

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Portage Bay (UW) Coho Program

1.2) Species and population (or stock) under propagation, and ESA status.

Lake Washington Coho (*Onchorynchus kisutch*) - not listed

1.3) Responsible organization and individuals

Name (and title): Mark Tetrick, Operations Manager
Agency or Tribe: University of Washington
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Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

1.4) Funding source, staffing level, and annual hatchery program operational costs.

Funding source is the state of Washington with staffing consisting of one full-time Operations Manager, a full-time Assistant Hatchery Manager and 2-10 part-time hourly Hatchery Technicians depending on the season. The facility also supports a part-time Tour and Outreach Coordinator and one vocational rehabilitation volunteer from Harborview or University of Washington Medical Center.

The School of Aquatic and Fishery Sciences provides administrative staff support and a faculty steering committee for development of overall programmatic goals.

The annual cost to the School is \$110,000 per annum. This figure includes instructional support but does not include the subsidy from the University of Washington (land, physical space, electricity).

1.5) Location(s) of hatchery and associated facilities.

Include name of stream, river kilometer location, basin name, and state. Also include watershed code (e.g. WRIA number), regional mark processing center code, or other sufficient information for GIS entry. See Instruction E for guidance in responding.

Portage Bay Hatchery: 1122 NE Boat St., Seattle, Washington 98501
Latitude 47°38' "55.14", Longitude 122°18'
"33.35"

1.6) Type of program.

Isolated research

1.7) Purpose (Goal) of program.

Research: Provide salmonid stocks and fish culture space to support research programs by University of Washington faculty, research scientists, graduate students and other affiliated research organizations such as NOAA Fisheries, USGS and WDFW.

Education: Provide salmonid stocks and fish culture space in order to support educational activities for undergraduate and graduate students within the University of Washington and also to provide K-12 outreach opportunities for Puget Sound region schools.

1.8) Justification for the program.

The UW facility provides coho salmon at different life stages for research and educational use. The hatchery maintains a dedicated and flexible resource to support cutting-edge research and education pertaining to the biology, ecology, aquaculture and conservation of the salmonid species. This research is applicable not only to the Lake Washington watershed, but also across the species range.

The UW hatchery stock is relatively isolated and is produced specifically for research. The run reduces the need to use naturally produced coho salmon for research purposes, thereby, allowing a greater degree of freedom in the type of research that can be conducted at either at a harvest augmentation hatchery or on naturally produced stocks.

Although secondary to the primary goals of the program, the UW Portage Bay Hatchery currently produces harvestable numbers of coho salmon. This benefit may reduce harvest pressures on naturally produced coho salmon in the Lake Washington watershed.

1.9) List of program Performance Standards .

1.10) List of program Performance Indicators , designated by "benefits" and "risks."

1.11) Expected size of program.

In responding to the two elements below, take into account the potential for increased fish production that may result from increased fish survival rates effected by improvements in hatchery rearing methods, or in the productivity of fish habitat.

1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).

200,000 egg take goal: Number of adults needed ~ 180 (1:1 female:male)

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location. *(Use standardized life stage definitions by species presented in Attachment 2).*

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry		
Fingerling		
Yearling	Portage Bay	90,000

*-20,000 eyed eggs and 7,000 green eggs are transferred to local area schools for short term rearing and release into various local streams.

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

1.13) Date program started (years in operation), or is expected to start.

50+ years

1.14) Expected duration of program.

Ongoing

1.15) Watersheds targeted by program.

Lake Washington (08)

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

NA

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS.

2.1) List all ESA permits or authorizations in hand for the hatchery program.

None

2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.

2.2.1) Description of ESA-listed salmonid population(s) affected by the program.

- Identify the ESA-listed population(s) that will be directly affected by the program.

None

- Identify the ESA-listed population(s) that may be incidentally affected by the program.

Issaquah (Lake Washington) Summer/Fall Chinook

Most naturally-spawned Lake Washington chinook migrate to salt water after spending only a few months in freshwater. Arrival of both hatchery and naturally-produced smolts in the estuary peaks in late May, and after a few weeks, most begin moving to near-shore feeding grounds in Puget Sound and the Pacific Ocean. Sexually mature fish begin arriving back at the Ballard Locks as early as June. The peak counts at the Chittenden Locks is usually in early to mid-August.

N. Lake Washington Tribs Summer/Fall Chinook, Cedar River Summer/Fall Chinook

There are naturally spawning adult chinook in tributaries throughout the Lake Washington basin, however, their genetic origin is uncertain. There are genetically distinct chinook in the Cedar River. Adults spawn in the mainstem Cedar River from about river mile 1.0 in Renton to the City of Seattle water pipeline crossing at river mile 21.3. In 1999, 81% of the chinook redds were observed above river mile 6.5 and the first redd observed was on August 18. Spawning activity peaks in early October and is generally complete by early to mid-November. Big Bear/Cottage, Issaquah, and Kelsey Creeks also have significant numbers of spawners. Recent genetic testing (1999 broodyear) of Bear Creek chinook indicate that they are very similar to the Issaquah Hatchery stock.

2.2.2) Status of ESA-listed salmonid population(s) affected by the program.

- Describe the status of the listed natural population(s) relative to critical and viable population thresholds (see definitions in Attachment 1").

Critical and viable population thresholds under ESA have not been determined, however, the SASSI report (WDFW) determined this population (Issaquah (Lake Washington) Summer/ Fall Chinook) status to be "healthy" while the N. Lake Washington Tribes and Cedar River Summer/Fall Chinook are "unknown".

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.

The table below provides the Lake Washington chinook broodyear escapement, subsequent reconstructed run size and return per spawner. This information is for natural spawners in Bear/Cottage and the Cedar River mainstem. The source of these data are from WDFW run reconstruction tables.

Return Year	Run size	Brood Year Escapement	Return/ Spawner
1988	2,769	1,252	2.2117
1989	1,832	949	1.9305
1990	1,214	1,470	0.8259
1991	1,517	2,038	0.7444
1992	1,407	792	1.7765
1993	321	1,011	0.3175
1994	924	787	1.1741
1995	969	661	1.4660
1996	345	790	0.4367
1997	305	245	1.2449
1998	700	888	0.7883
1999	791	930	0.8511
2000		336	
2001		294	

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data. (Include estimates of juvenile habitat seeding relative to capacity or natural fish densities, if available).

Live count Area Under the Curve index spawning escapement estimates for the Cedar River mainstem, Bear Creek and Cottage Lake creeks. There is no expansion to unsurveyed sections or for fish not seen (WDFW data).

Return Year	Cedar	Cottage	Bear	System Total
1983	788	403	141	1332
1984	898	264	90	1252
1985	766	124	59	949
1986	942	386	142	1470
1987	1540	226	272	2038
1988	559	50	183	792
1989	558	208	245	1011
1990	469	161	157	787
1991	508	93	60	661
1992	525	75	190	790
1993	156	44	45	245
1994	452	186	250	888
1995	681	143	106	930
1996	303	6	19	328
1997	227	42	25	294
1998	432	192	73	697
1999	241	258	279	778

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

There are no estimates of direct hatchery-origin chinook on the spawning grounds. There are no recent coded-wire tag releases in the Lake Washington system, therefore, there are no adipose-fin clipped released chinook. The 2000 releases were mass marked (adipose-fin clip only) so the hatchery percentages may be available in the future. It is assumed that a high percentage of natural spawners in Issaquah Creek are of hatchery origin.

2.2.3) Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take (see Attachment 1" for definition of take).

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

The release of fish as described in this HGMP could potentially result in ecological interactions with listed species. These potential ecological interactions are discussed in Section 3.5, and risk control measures are discussed in Section 10.11. Implementation of the program modifications provided in this HGMP, and the actions previously taken by the comanagers, are anticipated to contribute to the continued improvement in the abundance of listed salmonids.

- Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.

Unknown

- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

Complete the appended take table (Table 1) for this purpose. Provide a range of potential take numbers to account for alternate or worst case scenarios.

See "take" table

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

(e.g. The number of days that steelhead are trapped at Priest Rapids Dam will be reduced if the total mortality of handled fish is projected inseason to exceed the 1988-99 maximum observed level of 100 fish.)

The Portage Bay Hatchery will undergo a constant review for possible take situations. If the review indicates an unacceptable level of "take", then a solution will be negotiated with management agencies.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. Hood Canal Summer Chum Conservation Initiative) or other regionally accepted policies (e.g. the NPPC Annual Production Review Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

(e.g. The hatchery program will be operated consistent with the ESU-wide plan, with the exception of age class at release. Fish will be released as yearlings rather than as sub-yearlings as specified in the ESU-wide plan, to maximize smolt-to-adult survival rates given extremely low run sizes the past four years.).

The hatchery program is not aligned with any specific ESU-wide hatchery plan.

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

The program operates within the review of a committee comprising UW faculty and staff, UW/USGS co-op representatives and affiliate faculty from USGS and NOAA Fisheries. The evaluation of the research program (s) will be directly related to its relevance to ESU issues as well as to the biology and culture of salmonid species.

3.3) Relationship to harvest objectives.

3.3.1) Describe fisheries benefitting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

There is no directed harvest on this stock. Although, incidental harvest may occur in the ocean and in the Sound.

3.4) Relationship to habitat protection and recovery strategies.

The comanagers resource management plans for artificial production in Puget Sound are expected to be one component of a recovery plan for Puget Sound chinook under development through the Shared Strategy process. Several important analyses have been completed, including the identification of populations of Puget Sound chinook, but further development of the plan may result in an improved understanding of the habitat, harvest, and hatchery actions required for recovery of Puget Sound chinook.

3.5) Ecological interactions.

The program described in this HGMP interacts with the biotic and abiotic components of the freshwater, estuarine, and marine salmonid ecosystem through a complex web of short and longterm processes. The complexity of this web means that secondary or tertiary interactions (both positive and negative) with listed species could occur in

multiple time periods, and that evaluation of the net effect can be difficult. WDFW is not aware of any studies that have directly evaluated the ecological effects of this program. Alternatively, we provide in this section a brief summary of empirical information and theoretical analyses of three types of ecological interactions, nutrient enhancement, predation, and competition, that may be relevant to this program. Recent reviews by Fresh (1997), Flagg et al. (2000), and Stockner (2003) can be consulted for additional information; NMFS (2002) provides an extensive review and application to ESA permitting of artificial production programs.

Nutrient Enhancement

Adults originating from this program that return to natural spawning areas may provide a source of nutrients in oligotrophic coastal river systems and stimulate stream productivity. Many watersheds in the Pacific Northwest appear to be nutrient-limited (Gregory et al. 1987; Kline et al. 1997) and salmonid carcasses can be an important source of marine derived nutrients (Levy 1997). Carcasses from returning adult salmon have been found to elevate stream productivity through several pathways, including: 1) the releases of nutrients from decaying carcasses has been observed to stimulate primary productivity (Wipfli et al. 1998); 2) the decaying carcasses have been found to enrich the food base of aquatic invertebrates (Mathisen et al. 1988); and 3) juvenile salmonids have been observed to feed directly on the carcasses (Bilby et al. 1996). Addition of nutrients has been observed to increase the production of salmonids (Slaney and Ward 1993; Slaney et al. 2003; Ward et al. 2003).

Predation Freshwater Environment

Coho and steelhead released from hatchery programs may prey upon listed species of salmonids, but the magnitude of predation will depend upon the characteristic of the listed population of salmonids, the habitat in which the population occurs, and the characteristics of the hatchery program (e.g., release time, release location, number released, and size of fish released). The site specific nature of predation, and the limited number of empirical studies that have been conducted, make it difficult to predict the predation effects of any specific hatchery program. WDFW is unaware of any studies that have empirically estimated the predation risks to listed species posed by the program described in this HGMP.

In the absence of site-specific empirical information, the identification of risk factors can be a useful tool for reviewing hatchery programs while monitoring and research programs are developed and implemented. Risk factors for evaluating the potential for significant predation include the following:

Environmental Characteristics. Water clarity and temperature, channel size and configuration, and river flow are among the environmental characteristics that can influence the likelihood that predation will occur (see SWIG (1984) for a review). The SIWG (1984) concluded that the potential for predation is greatest in small streams with flow and turbidity conditions conducive to high visibility.

Relative Body Size. The potential for predation is limited by the relative body size of fish released from the program and the size of prey. Generally, salmonid predators are thought to prey on fish approximately 1/3 or less their length (USFWS 1994), although coho salmon have been observed to consume juvenile chinook salmon of up to 46% of their total length (Pearsons et al. 1998). The lengths of juvenile migrant chinook salmon originating from natural production have been monitored in numerous watersheds throughout Puget Sound, including the Skagit River, Stillaguamish River, Bear Creek, Cedar River, Green River, Puyallup River, and Dungeness River. The average size of migrant chinook salmon is typically 40mm or less in February and March, but increases in the period from April through June as emergence is completed and growth commences (Table 3.5.1). Assuming that the prey item can be no greater than 1/3 the length of the predator, Table 3.5.1 can be used to determine the length of predator required to consume a chinook salmon of average length in each time period. The increasing length of natural origin juvenile chinook salmon from March through June indicates that delaying the release hatchery smolts of a fixed size will reduce the risks associated with predation.

Table 3.5.1. Average length by statistical week of natural origin juvenile chinook salmon migrants captured in traps in Puget Sound watersheds. The minimum predator length corresponding to the average length of chinook salmon migrants, assuming that the prey can be no greater than 1/3 the length of the predator, are provided in the final row of the table. (NS: not sampled.)

Watershed	Statistical Week										
	16	17	18	19	20	21	22	23	24	25	26
Skagit ¹ 1997-2001	43.2	48.3	50.6	51.7	56.1	59.0	58.0	60.3	61.7	66.5	68.0
Stillaguamish ² 2001-2002	51.4	53.5	55.7	57.8	60.0	62.1	64.2	66.4	68.5	70.6	72.8
Cedar ³ 1998-2000	54.9	64.2	66.5	70.2	75.3	77.5	80.7	85.5	89.7	99.0	113
Green ⁴ 2000	52.1	57.2	59.6	63.1	68.1	69.5	NS	79.0	82.4	79.4	76.3
Puyallup ⁵ 2002	NS	NS	NS	66.2	62.0	70.3	73.7	72.7	78.7	80.0	82.3
Dungeness ⁶ 1996-1997	NS	NS	NS	NS	NS	NS	NS	NS	77.9	78.8	81.8
All Systems Average Length	50.4	55.8	58.1	61.8	64.3	67.7	69.2	72.8	76.5	79.0	82.4
Minimum Predator Length	153	169	176	187	195	205	210	221	232	239	250

Sources:

¹ Data are from Seiler et al. (1998); Seiler et al. (1999); Seiler et al. (2000); Seiler et al. (2001), and Seiler et al. (2002)..

² Data are from regression models presented in Griffith et al. (2001) and Griffith et al. (2003).

³ Data are from Seiler et al. (2003).

⁴ Data are from Seiler et. (2002).

⁵ Data are from Samarin and Sebastian (2002).

⁶ Data are from Marlowe et al. (2001).

Date of Release. The release date of juvenile fish for the program can influence the likelihood that listed species are encountered or are of a size that is small enough to be consumed. The most extensive studies of the migration timing of naturally produced juvenile chinook salmon in the Puget Sound ESU have been conducted in the Skagit River, Bear Creek, Cedar River, and the Green River. Although distinct differences are evident in the timing of migration between watersheds, several general patterns are beginning to emerge:

- 1) Emigration occurs over a prolonged period, beginning soon after enough emergence (typically January) and continuing at least until July;
- 2) Two broad peaks in migration are often present during the January through July time period; an early season peak (typically in March) comprised of relatively small chinook salmon (40-45mm), and a second peak in mid-May to June comprised of larger chinook salmon;
- 3) On average, over 80% of the juvenile chinook have migrated past the trapping locations after statistical week 23 (usually occurring in the first week of June).

Table 3.5.2. Average cumulative proportion of the total number of natural origin juvenile chinook salmon migrants estimated to have migrated past traps in Puget Sound watersheds.

Watershed	Statistical Week										
	16	17	18	19	20	21	22	23	24	25	26
Skagit ¹ 1997-2001	0.61	0.64	0.68	0.73	0.76	0.78	0.83	0.86	0.90	0.92	0.94
Bear ² 1999-2000	0.26	0.27	0.28	0.32	0.41	0.52	0.73	0.84	0.92	0.96	0.97
Cedar ² 1999-2000	0.76	0.76	0.76	0.77	0.79	0.80	0.82	0.84	0.87	0.88	0.90
Green ³ 2000	0.63	0.63	0.64	0.69	0.77	0.79	0.84	0.86	0.88	0.98	1.00
All Systems Average	0.56	0.58	0.59	0.63	0.68	0.72	0.80	0.85	0.89	0.94	0.95

Sources:

¹ Data are from Seiler et al. (1998); Seiler et al. (1999); Seiler et al. (2000); Seiler et al. (2001), and Seiler et al. (2002)..

² Data are from Seiler et al. (2003).

³ Data are from Seiler et. (2002).

Release Location and Release Type. The likelihood of predation may also be affected by the location and type of release. Other factors being equal, the risk of predation may increase with the length of time the fish released from the artificial production program are commingled with the listed species. In the freshwater environment, this is likely to be affected by distribution of the listed species in the watershed, the location of the release, and the speed at which fish released from the program migrate from the watershed.

Coho salmon and steelhead released from western Washington artificial production programs as smolts have typically been found to migrate rapidly downstream. Data from Seiler et al. (1997; 2000) indicate that coho smolts released from the Marblemount Hatchery on the Skagit River migrate approximately 11.2 river miles day. Steelhead smolts released onstation may travel even more rapidly migration rates of approximately 20 river miles per day have been observed in the Cowlitz River (Harza 1998). However, trucking fish to offstation release sites, particularly release sites located outside of the watershed in which the fish have been reared, may slow migrations speeds (Table 3.5.3).

Table 3.5.3. Summary of travel speeds for steelhead smolts for several types of release strategies.

Location	Release Type	Migration Speed (river miles per day)	Source
Cowlitz River	Smolts, onstation	21.3	Harza (1998)
Kalama River	Trucked from facility located within watershed in which fish were released.	4.4	Hulett (pers. comm.)
Bingham Creek	Trucked from facility located outside of watershed in which fish were released.	0.6	Seiler et al. (1997)
Stevens Creek	Trucked from facility located outside of watershed in which fish were released.	0.5	Seiler et al. (1997)
Snow Creek	Trucked from facility located outside of watershed in which fish were released.	0.4	Seiler et al. (1997)

Number Released. Increasing the number of fish released from an artificial production program may increase the risk of predation, although competition between predators for prey may eventually limit the total consumption (Peterman and Gatto 1978).

Predation Marine Environment

WDFW is unaware of any studies that have empirically estimated the predation risks to listed species posed by the program described in this HGMP. NMFS (2002) reviewed existing information on the risks of predation in the marine environment posed by artificial production programs and concluded:

- 1) Predation by hatchery fish on natural-origin smolts or sub-adults is less likely to occur than predation on fry. Coho and chinook salmon, after entering the marine environment, generally prey upon fish one-half their length or less and consume, on average, fish prey that is less than one-fifth of their length (Brodeur 1991). During early marine life, predation on natural origin chinook, coho, and steelhead will likely be highest in situations where large, yearling-sized hatchery fish encounter sub-yearling fish or fry (SIWG 1984).
- 2) However, extensive stomach content analysis of coho salmon smolts collected through several studies in marine waters of Puget Sound, Washington do not substantiate any indication of significant predation upon juvenile salmonids (Simenstad and Kinney 1978).
- 3) Likely reasons for apparent low predation rates on salmon juveniles, including chinook, by larger chinook and other marine predators are described by Cardwell and Fresh (1979). These reasons included: 1) due to rapid growth, fry are better able to elude predators and are accessible to a smaller proportion of predators due to size alone; 2) because fry have dispersed, they are present in low densities relative to other fish and invertebrate prey; and 3) there has either been learning or selection for some predator avoidance.

Competition

WDFW is unaware of any studies that have empirically estimated the competition risks to listed species posed by the program described in this HGMP. Studies conducted in other areas indicate that this program is likely to pose a minimal risk of competition:

- 1) As discussed above, coho salmon and steelhead released from hatchery programs as smolts typically migrate rapidly downstream. The SIWG (1984) concluded that migrant fish will likely be present for too short a period to compete with resident salmonids.
- 2) NMFS (2002) noted that "...where interspecific populations have evolved sympatrically, chinook salmon and steelhead have evolved slight differences in habitat use patterns that minimize their interactions with coho salmon (Nilsson 1967; Lister and Genoe 1970; Taylor 1991). Along with the habitat differences exhibited by coho and steelhead, they also show differences in foraging behavior. Peterson (1966) and Johnston (1967) reported that juvenile coho are surface oriented and feed primarily on drifting and flying insects, while steelhead are bottom oriented and feed largely on benthic invertebrates.

3) Flagg et al. (2000) concluded, By definition, hatchery and wild salmonids will not compete unless they require the same limiting resource. Thus, the modern enhancement strategy of releasing salmon and steelhead trout as smolts markedly reduces the potential for hatchery and wild fish to compete for resources in the freshwater rearing environment. Miller (1953), Hochachka (1961), and Reimers (1963), among others, have noted that this potential for competition is further reduced by the fact that many hatchery salmonids have developed different habitat and dietary behavior than wild salmonids. Flagg et al (2000) also stated It is unclear whether or not hatchery and wild chinook salmon utilize similar or different resources in the estuarine environment.

4) Fresh (1997) noted that Few studies have clearly established the role of competition and predation in anadromous population declines, especially in marine habitats. A major reason for the uncertainty in the available data is the complexity and dynamic nature of competition and predation; a small change in one variable (e.g., prey size) significantly changes outcomes of competition and predation. In addition, large data gaps exist in our understanding of these interactions. For instance, evaluating the impact of introduced fishes is impossible because we do not know which nonnative fishes occur in many salmon-producing watersheds. Most available information is circumstantial. While such information can identify where inter- or intra specific relationships may occur, it does not test mechanisms explaining why observed relations exist. Thus, competition and predation are usually one of several plausible hypotheses explaining observed results. _

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

For integrated programs, identify any differences between hatchery water and source, and natal water used by the naturally spawning population. Also, describe any methods applied in the hatchery that affect water temperature regimes or quality. Include information on water withdrawal permits, National Pollutant Discharge Elimination System (NPDES) permits, and compliance with NMFS screening criteria.

Portage Bay hatchery utilizes three different water sources to rear fish. The primary source for the facility is surface water drawn from Portage Bay. A well water source and domestic (city water) source are also utilized, depending on time of year, fish life stage and research needs. In addition the facility has a limited ability to warm surface water drawn from Portage Bay

Surface Water: Lake water is pumped from Portage Bay at up to ~2,200gpm. The volume fluctuates seasonally between ~800gpm and ~2,000gpm, depending on fish rearing requirements. Lake water temperature ranges between 7 c and 26 C, depending on the season, weather conditions and time of day.

Well Water: A ground water intrusion well located on upper campus provides the Portage Bay hatchery with ~120gpm. This water source is delivered via the campus utility tunnel system, resulting in a stable annual temperature of ~20 c. Well water is mixed with the facility's surface water source from January to April in order to maintain fish rearing water temperatures above 10 C.

Domestic Water: The facility has the capability to de-chlorinate and cold sterilize (1 mic. absolute) up to 12gpm of City of Seattle domestic water. This source is primarily used for incubation of salmonid eggs. Temperature varies annually from ~6 c to ~20 c.

Heated Surface Water: Utilizing a heat exchanger and the available steam resource on campus, the facility has the capability to warm ~200gpm of the existing lake water supply. The lake water heat exchanger is capable of a maximum ΔT of ~25 C at 200gpm. This source is utilized from January to April in order to maintain fish rearing water temperatures above 10 C.

Year round production of most salmonid species and/or stocks is currently not possible at the Portage Bay hatchery due to elevated water temperatures during July, August and early September. Lake water pumped from Portage Bay is usually above 22 C for most of the summer months.

The water sources listed above are also utilized for instructional and research needs. For this reason, all of the facility's water resources are not typically available for salmonid production purposes.

4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

Because of pumphouse design, it is unlikely Portage Bay hatchery withdrawal of surface water will lead to any take of listed salmonid species. Surface water is drawn through a layered bed of gravel and sand approximately 5,000 sq. ft. in surface area and 2-3m deep. This type of intake has no perceptible intake suction and a maximum passable particle size of <100 mic., and meets the NMFS screening criteria. Portage Bay hatchery fish production is substantially less than the 20,000 pounds of fish per year criteria set by Washington DOE as the limit for concern of hatchery effluent discharge and the requirement for an NPDES permit. Due to relatively low fish production and the degraded ecological nature of Portage Bay, it is unlikely that discharge from the facility will lead to adverse effects on water quality or any take of listed fish.

SECTION 5. FACILITIES

Provide descriptions of the hatchery facilities that are to be included in this plan (see Guidelines for Providing Responses Item E), including dimensions of trapping, holding incubation, and rearing facilities. Indicate the fish life stage held or reared in each. Also describe any instance where operation of the hatchery facilities, or new construction, results in destruction or adverse modification of critical habitat designated for listed salmonid species.

5.1) Broodstock collection facilities (or methods).

Returning adult coho are held in a pond, about 100 feet (35m) in diameter. The bottom of the pond is gravel. The water level varies from two to about 5 feet in depth (avg. depth 1.5 m). The pond is an extension of the Fisheries Center waterfront facilities, which in turn has a constant flow of circulating water pumped from Portage Bay. The coho enter the pond via a small fish ladder connecting Portage Bay to the hatchery pond. The returning adult coho are held in the pond for the remainder of their lives where the final process of artificial spawning is also performed.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

NA

5.3) Broodstock holding and spawning facilities.

Adult coho are captured and held in the pond via a fish ladder. Spawning is performed on a concrete pad adjacent to the pond.

5.4) Incubation facilities.

Eggs are reared in Heath trays. Cold sterilized de-chlorinated domestic water is passed through a serial reuse system (a partially closed re-circulation system). About 5 gallons per min of water is delivered to the incubation systems. Each incubator system comprises 5 full stacks heath trays- we currently have 2 systems. Some back up eggs are raised in single pass surface water for supplementation of losses to the production and for research. Konnecki incubators are used for research work.

5.5) Rearing facilities.

Fry and fingerlings are reared in different facilities, according to stage of development.

Inside hatchery facilities: twenty-four troughs approx 30 feet long, 12 inches wide, 6 inches deep, four 6-4 feet diameter circular tanks, fifteen 3 ft diameter polyethylene circulars

Outside facilities: 6 x 40 foot by 5 feet wide 4 feet deep concrete raceways. Gravel pond depth changes to 2 meters (see 5.1).

5.6) Acclimation/release facilities.

Gravel pond (see 5.1).

Water sources: Portage Bay surface water temperature varies between 10 to 16 degrees. Fingerlings are moved to the pond and exposed to lake water, as well as a small leak of hatchery effluent distributed via venturi to scent the pond.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

There have been no recent events. One electrical and pump failure occurred about 10 years ago and fish were rapidly released. Fingerlings are released in May to correspond with increased invertebrate blooms as an increased food source. Occasionally, severe algal blooms result from increased sun exposure and water temperatures during this month. These blooms sometimes create the need to release fish early and can cause increased fingerling mortality as overnight oxygen levels plummet.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

We do not handle listed natural fish and there are no spawning populations in the vicinity.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.

6.1) Source.

Coho brood sources have been a mixture of coho stocks in the past. Priority is given to using returning U of W, Portage Bay stock. Issaquah Hatchery stock often stray into the adult pond and are used as broodstock.

6.2) Supporting information.

6.2.1) History.

See section 6.1

6.2.2) Annual size.

Wild-origin adult coho are not knowingly used as broodstock.

6.2.3) Past and proposed level of natural fish in broodstock.

See 6.2.2

6.2.4) Genetic or ecological differences.

None known

6.2.5) Reasons for choosing.

Most locally adapted stock.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

NA

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

Returning adult chinook salmon and their eggs will be collected at the UW hatchery pond during the spawning season.

7.2) Collection or sampling design.

Returning adult coho are collected by beach seine from the UW hatchery pond (4.5 miles from Puget Sound), located next to the shoreline of Portage Bay, from the beginning of the run (late-September) to the end of the run (mid to late-December). Capture efficiency is 100%. All coho salmon that enter the pond via the fish ladder remain until they mature and are spawned artificially. The coho salmon are spawned three times a week (Mon., Wed., and Fri.). An allotted number of coho are captured each week. Thus, a random representative sample of the broodstock source (~90 pairs) is collected throughout the spawning season. The broodstock are not selected based on any phenotypic criteria (but see the exception with early maturing males Section 6.2.4).

7.3) Identity.

Fish returning to the holding pond.

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults):

180 adults

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

Year	Adults Females	Males	Jacks	Eggs	Juveniles
1988					
1989					
1990					
1991					
1992					
1993					
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001					

Data source: UW hatchery facility

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

7.6) Fish transportation and holding methods.

NA

7.7) Describe fish health maintenance and sanitation procedures applied.

A sample (usually 60 – 65 fish) of the hatchery chinook captured for broodstock will be virology tested in accordance with procedures set forth in the Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State (WDFW 1966). Artificial spawning will occur in sterile containers that will be cleaned and sterilized after each use.

7.8) Disposition of carcasses.

Spawned and unspawned carcasses are frozen and held for the next scheduled landfill dump. We propose that some of the spawned and unspawned carcasses be used for stream reseedling after they are tested for viruses and any other diseases. Should this proposal be supported, a carcass distribution report will be made for each distribution site.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

NA

SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1) Selection method.

8.2) Males.

8.3) Fertilization.

8.4) Cryopreserved gametes.

NA

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

SECTION 9. INCUBATION AND REARING -

Specify any management *goals* (e.g. egg to smolt survival) that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

9.1.2) Cause for, and disposition of surplus egg takes.

9.1.3) Loading densities applied during incubation.

9.1.4) Incubation conditions.

9.1.5) Ponding.

9.1.6) Fish health maintenance and monitoring.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.

9.2) Rearing:

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available..

9.2.2) Density and loading criteria (goals and actual levels).

9.2.3) Fish rearing conditions

9.2.4) Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

Specify any management goals (e.g. number, size or age at release, population uniformity, residualization controls) that the hatchery is operating under for the hatchery stock in the appropriate sections below.

10.1) Proposed fish release levels. *(Use standardized life stage definitions by species presented in **Attachment 2**. Location is watershed planted (e.g. Elwha River).)*

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs				
Unfed Fry				
Fry				
Fingerling	90,000	30**	May	Portage Bay
Yearling				

** Accelerated rearing program results in 0 age smolts.

*--20,000 eyed eggs and 7,000 green eggs are transferred to local area schools for short term rearing and release into various local streams.

10.2) Specific location(s) of proposed release(s).

Stream, river, or watercourse:	Lake Washington (08)
Release point:	Portage Bay (08)
Major watershed:	Lake Washington
Basin or Region:	Puget Sound

10.3) Actual numbers and sizes of fish released by age class through the program.

*For existing programs, provide fish release number and size data for the past three fish generations, or approximately the past 12 years, if available. Use standardized life stage definitions by species presented in **Attachment 2**. Cite the data source for this information.*

Release year	Eggs/ Unfed Fry	Avg size	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
1988								
1989								
1990								
1991								
1992								
1993								
1994								
1995								
1996								
1997								
1998								
1999								
2000								
2001								
Average								

Data source: UW hatchery facility

10.4) Actual dates of release and description of release protocols.

10.5) Fish transportation procedures, if applicable.

NA

10.6) Acclimation procedures (methods applied and length of time).

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

10.9) Fish health certification procedures applied pre-release.

10.10) Emergency release procedures in response to flooding or water system failure.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

Fish are released at a size (30fpp) and stage (fully smolted) that reduces the risk of adverse ecological interactions.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

This section describes how Performance Indicators listed in Section 1.10 will be monitored. Results of Performance Indicator monitoring will be evaluated annually and used to adaptively manage the hatchery program, as needed, to meet Performance Standards .

11.1) Monitoring and evaluation of Performance Indicators presented in Section 1.10.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to each Performance Indicator identified for the program.

The comanagers conduct numerous ongoing monitor programs, including catch, escapement, marking, tagging, and fish health testing. The focus of enhanced monitoring and evaluation programs will be on the risks posed by ecological interactions with listed species. WDFW is proceeding on four tracks:

- 1) An ongoing research program conducted by Duffy et al. (2002) is assessing the nearshore distribution, size structure, and trophic interactions of juvenile salmon, and potential predators and competitors, in northern and southern Puget Sound. Funding is provided through the federal Hatchery Scientific Review Group.
- 2) A three year study of the estuarine and early marine use of Sinclair Inlet by juvenile salmonids is nearing completion. The project has four objectives:
 - a) Assess the spatial and temporal use of littoral habitats by juvenile chinook throughout the time these fish are available in the inlet;
 - b) Assess the use of offshore (i.e., non-littoral) habitats by juvenile chinook;
 - c) Determine how long cohorts of juvenile chinook salmon are present in Sinclair inlet;
 - d) Examine the trophic ecology of juvenile chinook in Sinclair Inlet. This will consist of evaluating the diets of wild chinook salmon and some of their potential predators and competitors. Funding is provided by the USDD-Navy.
- 3) WDFW is developing the design for a research project to assess the risks of predation on listed species by coho salmon and steelhead released from artificial production programs. Questions which this project will address include:
 - a) How does trucking and the source of fish (within watershed or out of watershed) affect the migration rate of juvenile steelhead?
 - b) How many juvenile chinook salmon of natural origin do coho salmon and steelhead consume?
 - c) What is the rate of residualism of steelhead in Puget Sound rivers?Funding needs have not yet been quantified, but would likely be met through a combination of federal and state sources.

4) WDFW is assisting the Hatchery Scientific Review Group in the development of a template for a regional monitoring plan. The template will provide an integrated assessment of hatchery and wild populations.

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

See Section 11.1.1.

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.

Risk aversion measures will be developed in conjunction with the monitoring and evaluation plans.

SECTION 12. RESEARCH

12.1) Objective or purpose.

Fish are used for research activities at the University of Washington.

12.2) Cooperating and funding agencies.

12.3) Principle investigator or project supervisor and staff.

12.4) Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.

12.5) Techniques: include capture methods, drugs, samples collected, tags applied.

12.6) Dates or time period in which research activity occurs.

12.7) Care and maintenance of live fish or eggs, holding duration, transport methods.

12.8) Expected type and effects of take and potential for injury or mortality.

12.9) Level of take of listed fish: number or range of fish handled, injured, or killed by sex, age, or size, if not already indicated in Section 2 and the attached take table (Table 1).

12.10) Alternative methods to achieve project objectives.

12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.

12.12) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

I hereby certify that the foregoing information is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973.

Name, Title, and Signature of Applicant:

Certified by _____ Date: _____

Table 1. Estimated listed salmonid take levels of by hatchery activity.

Listed species affected: Chinook ESU/Population: Puget Sound Activity: Hatchery Operations				
Location of hatchery activity: Portage Bay (Lk. Wash.) Dates of activity: October-May Hatchery program operator: University of Wash. (Dawgs)				
Type of Take	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
	Egg/Fry	Juvenile/S molt	Adult	Carcass
	Observe or harass a)			
	Collect for transport b)			
	Capture, handle, and release c)			
	Capture, handle, tag/mark/tissue sample, and release d)			
	Removal (e.g. broodstock) e)			
	Intentional lethal take f)			
	Unintentional lethal take g)	Unknown	Unknown	
Other Take (specify) h)				

- Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
- Take associated with weir or trapping operations where listed fish are captured and transported for release.
- Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
- Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
- Listed fish removed from the wild and collected for use as broodstock.
- Intentional mortality of listed fish, usually as a result of spawning as broodstock.
- Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
- Other takes not identified above as a category.

Instructions:

- An entry for a fish to be taken should be in the take category that describes the greatest impact.
- Each take to be entered in the table should be in one take category only (there should not be more than one entry for the same sampling event).
- If an individual fish is to be taken more than once on separate occasions, each take must be entered in the take table.